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PRODUCTION OF EXPLOSIVES IN THE UNITED STATES

DURING THE CALENDAR YEAR 1913

COMPILED BY

ALBERT H. FAY

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PRODUCTION OF EXPLOSIVES IN THE UNITED STATES DURING THE CALENDAR YEAR 1913.

Compiled by ALBERT H. FAY.

INTRODUCTION.

The total production of explosives in the United States during the calendar year 1913, according to the figures received from manufacturers, was 463,514,881 pounds (231,757 short tons), as compared with 489,393,131 pounds (244,696 short tons) for 1912. This production is segregated as follows: Black powder, 194,146,747 pounds; "high" explosives other than permissible explosives, 241,682,364 pounds; and permissible explosives, 27,685,770 pounds.

These figures represent a decrease of 36,146,622 pounds of black powder and an increase of 7,212,872 pounds of high explosives and 3,055,500 pounds of permissible explosives.

As explosives are essential to mining, and the use of improved types of explosives lessens the dangers of mining, the Bureau of Mines undertook the compilation of information showing the total amount of explosives manufactured and used in the United States, its first report dealing with the year 1912. This is the second technical paper relating solely to the production of explosives that the bureau has issued. It is expected that similar publications will be compiled annually, and that with the cooperation of the manufacturers these statements will be published within a few weeks after the end of each year.

CLASSIFICATION OF EXPLOSIVES.

The production figures tabulated herein are classified as follows:

1. *Black blasting powder.*—All black powder with sodium or potassium nitrate as a constituent is here classified as black blasting powder.

2. *High explosives.*—Dynamite and all other high explosives of various trade names and compositions, except permissible explosives, are put in this class.

3. *Permissible explosives.*—In this class are included ammonium nitrate explosives, hydrated explosives, organic nitrate explosives, and certain nitroglycerin explosives containing an exsess of free

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water or carbon. All permissible explosives have passed certain tests of the Bureau of Mines, and are not to be regarded as permissible unless used in the manner specified by the bureau.[a]

SCOPE OF STATISTICS.

Table 1 gives for the calendar years 1912 and 1913 the production of those States wherein three or more manufacturers reported sales of explosives. States in which only one or two manufacturers reported sales were not segregated.

Tables 2, 3, and 4 give the total production by groups of States of black powder, high explosives, and permissible explosives, respectively. The States are grouped so as to include regions where the general conditions of mining are more or less similar, and yet so as to avoid publishing sales of individual companies.

Table 5 shows the total amount of explosives used in coal mining during the years 1912 and 1913. The table also shows that 138 men were killed in coal mines by explosives during 1913 and 133 during 1912. The number thus killed in 1911 was 134 and in 1910 was 176.

Table 6 shows the rapid increase in the production and sale of permissible explosives. It will be noted that in 1902 only 11,300 pounds of permissible explosives was used in coal mining, whereas in 1913 the quantity so used was 21,804,285 pounds. The quantity of permissible explosives used in the United States is larger than in a number of foreign countries. In 1912 it represented about 5 per cent of the total quantity of explosives produced and in 1913 6 per cent. The total amount of explosives used for the production of coal in 1913 was 209,352,938 pounds, of which about 10 per cent was of the permissible class as compared with 8 per cent in 1912. The use of permissible explosives in coal mining has had gratifying results, and few, if any, serious accidents can be attributed directly to their use.

Table 7 gives the quantity of permissible explosives used for mining coal in the various coal fields. The table shows that in 1913 about four-fifths of the permissible explosives manufactured were used for coal mining, the remaining 5,881,485 pounds being reported as "Other mining" and "All other purposes," as shown in Table 4.

Table 8 gives the total production of coal in the United States, by groups of States wherein mining conditions are similar. It also shows the amount of coal produced per pound of explosive used, the grouping of the States being the same as in Table 5.

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[a] Hall, Clarence, Snelling, W. O., and Howell, S. P., Investigations of explosives used in coal mines, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. Bull. 15, Bureau of Mines. 1912. 197 pp.

Hall, Clarence, and Howell, S. P.: Tests of permissible explosives. Bull. 66, Bureau of Mines. 1913. 313 pp.

The figures tabulated in this paper represent the reports of 38 manufacturers who operated their plants during 1913. The number of manufacturers reporting sales of black powder was 27, of high explosives 27, and of permissible explosives 18. A number of other companies reported their plants as having been idle during the year or as having been sold to other manufacturers.

The reports of manufacturers of fireworks and of ammunition are not included, inasmuch as the majority of these manufacturers purchase their explosives from one or more of the manufacturers of explosives.

ACKNOWLEDGMENTS.

The Bureau of Mines takes this opportunity to express its appreciation of the aid rendered by the manufacturers in furnishing the data compiled. The bureau is willing and ready at all times to receive and consider any suggestions whereby its publications may be improved so as to meet the requirements of the readers for whom they are published.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES.

The production and use of explosives in the United States are given in detail in the following table:

TABLE 1.—*Amount of explosives (excluding exports) manufactured in the United States and used in the various States during the calendar years 1912 and 1913.*

States.	1912			1913		
	Black blasting powder.	High explosives other than permissible.	Permissible explosives.	Black blasting powder.	High explosives other than permissible.	Permissible explosives.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Alabama	5,277,375	4,542,192	3,856,130	4,815,295	5,573,850	4,396,667
Alaska	(a)	(a)	(a)	(a)	3,571,470	....
Arizona	(a)	(a)	(a)	374,950	8,731,335	....
Arkansas	2,776,800	1,169,946	(a)	2,640,351	1,240,465	4,300
California	(a)	(a)	(a)	945,039	12,048,102	(a)
Colorado	2,668,300	7,268,790	656,858	2,010,750	7,760,290	684,687
Connecticut	921,325	677,759	5,600	64,146	710,518	(a)
Delaware	(a)	79,426	....	(a)	(a)	(a)
District of Columbia	....	(a)	....	(a)	(a)	....
Florida	91,950	1,770,182	(a)	37,950	2,187,268	....
Georgia	694,925	1,238,907	(a)	567,052	1,178,770	....
Idaho	296,200	3,749,470	(a)	273,150	3,995,415	(a)
Illinois	36,674,290	5,879,767	746,094	30,720,322	6,689,690	1,578,925
Indiana	12,503,525	2,634,435	(a)	11,934,476	2,452,364	81,750
Iowa	8,683,375	1,439,367	(a)	5,545,686	1,921,721	(a)
Kansas	11,262,555	2,417,112	63,350	2,513,588	3,293,798	32,275
Kentucky	6,435,150	2,629,495	292,933	6,449,308	3,687,345	467,550
Louisiana	(a)	877,813	(a)	(a)	1,146,162	(a)
Maine	157,225	666,305	....	134,565	831,484	(a)
Maryland	651,200	1,248,727	14,450	898,606	1,475,214	(a)
Massachusetts	126,650	1,579,630	(a)	212,972	1,497,992	(a)
Michigan	544,225	23,694,970	(a)	594,500	21,818,795	(a)
Minnesota	5,549,725	10,647,442	(a)	4,175,237	11,105,635	....
Mississippi	13,050	521,245	....	114,300	693,523	(a)
Missouri	4,334,750	17,262,890	(a)	3,846,378	15,712,677	(a)
Montana	3,306,050	(a)	(a)	2,699,065	8,751,955	(a)

[a] Represents the product of only one or two manufacturers, and is included in item "Not segregated," at bottom of column.

Table 1.—*Amount of explosives (excluding exports) manufactured in the United States and used in the various States, etc.*—Continued.

States.	1912			1913		
	Black blasting powder.	High explosives other than permissible.	Permissible explosives.	Black blasting powder.	High explosives other than permissible.	Permissible explosives.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Nebraska	152,475	217,310	....	117,753	263,450	(a)
Nevada	(a)	(a)	(a)	(a)	6,836,785	(a)
New Hampshire	51,162	266,503	....	16,100	172,550	....
New Jersey	(a)	1,976,054	(a)	99,469	2,175,336	(a)
New Mexico	1,178,250	1,798,225	(a)	1,141,550	1,955,230	(a)
New York	926,125	14,474,767	196,375	793,074	12,519,410	(a)
North Carolina	628,325	1,358,762	(a)	812,000	1,670,475	10,000
North Dakota	329,000	197,275	(a)	287,410	287,600	(a)
Ohio	7,565,700	6,639,698	36,550	6,707,134	7,272,123	20,600
Oklahoma	5,192,225	1,687,862	350,200	4,530,215	2,134,864	354,800
Oregon	(a)	4,070,160	....	(a)	4,538,430	....
Pennsylvania	72,199,900	32,059,187	8,108,612	64,173,135	36,532,915	9,836,050
Rhode Island	(a)	197,350	(a)	5,405	81,075	....
South Carolina	(a)	340,327	....	(a)	483,030	....
South Dakota	104,500	1,756,515	....	(a)	1,937,305	....
Tennessee	4,656,700	3,824,012	198,790	6,498,379	4,575,107	226,337
Texas	2,025,775	1,750,382	27,131	1,158,177	1,681,600	(a)
Utah	1,551,825	4,385,460	(a)	1,659,450	5,721,925	3,963,700
Vermont	340,062	270,250	....	273,102	331,450	....
Virginia	3,904,725	3,012,704	134,900	4,510,876	3,569,293	160,650
Washington	(a)	7,117,330	(a)	1,439,538	7,906,291	(a)
West Virginia	12,648,150	4,323,135	3,072,095	14,630,164	4,534,400	3,498,460
Wisconsin	250,300	5,303,415	143,150	118,976	5,876,207	(a)
Wyoming	3,078,275	199,275	95,700	2,645,600	461,735	258,650
Not segregated	10,541,250	45,247,664	6,631,352	961,554	87,940	2,110,369
Total	230,293,369	234,469,492	24,630,270	194,146,747	241,682,364	27,685,770
Grand total	**489,393,131**			**463,514,881**		

Represents the product of only one or two manufacturers, and is included in item "Not segregated," at bottom of column.

TABLE 2.—*Amount of black blasting powder used in the United States during 1912 and 1913, classified by use.*

Groups of States.	Black blasting powder, 1912.			Black blasting powder, 1913.			
	Coal mining.	Railway and other construction.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont		57,475	635,099		20,050	9,050	613,044
Group 2. Connecticut, New Jersey, and New York		149,800	1,809,250		56,225	191,500	708,964
Group 3. Delaware, District of Columbia, Maryland, and Virginia	1,677,300	2,168,600	714,725	3,048,351	50,000	1,168,650	1,147,781
Pennsylvania	64,326,275	3,471,625	4,402,000	61,119,482	489,900	559,711	2,004,042
West Virginia	11,414,550	700,150	533,450	13,859,944	125,000	258,675	386,545
Group 4. Florida, Georgia, North Carolina, and South Carolina	326,650	765,225	365,050	197,500	73,475	842,750	409,627
Group 5. Indiana and Kentucky	17,790,325	426,925	721,425	17,313,719	90,725	410,200	569,140
Illinois	36,437,290	34,400	202,600	30,226,670	20,700	29,375	443,577
Ohio	6,666,175	17,475	882,050	6,133,333	422,650	4,430	146,721
Group 6. Alabama, Mississippi, and Tennessee	7,853,075	1,213,775	880,275	7,532,574	300,550	1,380,325	2,214,525
Group 7. Michigan, Minnesota, and Wisconsin	725,500	109,200	5,509,550	533,175	4,127,162	60,650	167,726
Group 8. Iowa, Kansas, Missouri, and Nebraska	22,855,530	425,100	1,152,525	10,264,060	252,700	399,550	1,107,095
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	8,322,050	1,041,475	638,100	7,176,342	57,425	424,075	696,076
Group 10. Montana, North Dakota, South Dakota, and Wyoming	5,400,050	638,775	779,000	3,998,250	57,000	886,550	758,831
Group 11. Colorado, New Mexico, and Utah	2,502,775	977,375	1,918,725	1,806,960	690,500	1,309,300	1,004,990
Group 12. Alaska, Idaho, Oregon, and Washington	786,200	1,670,750	655,000	244,660	540	1,256,350	931,953
Group 13. Arizona, California, and Nevada	7,250	4,664,875	2,870,550		41,268	342,765	971,314
Total	187,090,995	18,533,000	24,669,374	163,455,020	6,875,870	9,533,906	14,281,951
Grand total	230,293,369			194,146,747			

TABLE 3.—*Amount of high explosives used in the United States during 1912 and 1913, classified by use.*

Groups of States.	High explosives other than permissible explosives, 1912.			High explosives other than permissible explosives, 1913.			
	Coal mining.	Other mining.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	2,000	45,475	2,932,563	....	26,850	1,006,716	1,880,985
Group 2. Connecticut, New Jersey, and New York	....	2,538,140	14,590,440	....	2,205,428	6,207,383	6,992,453
Group 3. Delaware, District of Columbia, Maryland, and Virginia	379,725	398,150	3,626,668	471,475	345,000	1,217,897	3,098,075
Pennsylvania	15,814,080	1,527,183	14,717,924	18,198,494	217,270	5,671,290	12,445,861
West Virginia	553,320	8,300	3,761,515	645,425	8,500	1,454,400	2,426,075
Group 4. Florida, Georgia, North Carolina, and South Carolina	2,300	328,735	4,377,143	5,680	327,585	1,537,722	3,648,556
Group 5. Indiana and Kentucky	351,225	52,000	4,860,705	699,201	57,400	1,594,900	3,788,208
Illinois	127,725	34,300	5,717,742	172,300	802,650	542,917	5,171,823
Ohio	160,400	271,350	6,207,948	62,360	378,625	300,750	6,530,388
Group 6. Alabama, Mississippi, and Tennessee	669,950	3,148,955	5,068,544	722,610	3,823,346	3,459,695	2,836,829
Group 7. Michigan, Minnesota, and Wisconsin	212,500	29,078,469	10,354,858	20,125	30,337,337	415,452	8,027,723
Group 8. Iowa, Kansas, Missouri, and Nebraska	1,391,940	14,437,075	5,507,664	1,430,550	13,089,350	503,610	6,168,136
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	582,325	594,600	4,309,078	455,050	1,218,500	473,458	4,056,083
Group 10. Montana, North Dakota, South Dakota, and Wyoming	120,400	7,838,925	1,711,185	145,975	8,084,080	968,125	2,240,415
Group 11. Colorado, New Mexico, and Utah	232,990	6,435,680	6,783,805	615,670	7,975,945	1,307,380	5,538,450
Group 12. Alaska, Idaho, Oregon, and Washington	253,000	4,596,920	12,767,195	424,068	6,686,770	2,723,618	10,177,150
Group 13. Arizona, California, and Nevada	49,550	18,368,824	16,568,004	24,650	16,508,640	3,136,962	7,945,970
Total	20,903,430	89,703,081	123,862,981	24,093,633	92,093,276	32,522,275	92,973,180
Grand total	**234,469,492**			**241,682,364**			

TABLE 4.—*Amount of permissible explosives used in the United States during 1912 and 1913, classified by use.*

Groups of States.	Permissible explosives, 1912.			Permissible explosives, 1913.			
	Coal mining.	Other mining.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	1,000		4,840			27,900	5,000
Group 2. Connecticut, New Jersey, and New York		158,575	52,200		461,700	2,000	28,700
Group 3. Delaware, District of Columbia, Maryland, and Virginia	144,550	2,250	2,550	134,000	17,500		19,650
Pennsylvania	7,880,992	60,225	167,395	9,622,475	5,000	16,400	192,175
West Virginia	3,064,045	4,000	4,050	3,282,560	20,000		195,900
Group 4. Florida, Georgia, North Carolina, and South Carolina		100	14,890		1,850		8,150
Group 5. Indiana and Kentucky	284,203	998	60,125	482,250	300	5,850	60,900
Illinois	740,417		5,677	1,569,175			9,750
Ohio	2,975	1,000	32,575	6,650	2,950		11,000
Group 6. Alabama, Mississippi, and Tennessee	3,995,485	17,100	42,335	4,481,975	114,590		26,639
Group 7. Michigan, Minnesota, and Wisconsin	470	63.200	147,900		2,000		13,400
Group 8. Iowa, Kansas, Missouri, and Nebraska	80,875	953,000	29,175	21,125	471,800	200	76,254
Group 9. Arkansas, Louisiana, Oklahoma, and Teaxs	359,500	45,700	16,581	356,500	41,850	1,525	1,775
Group 10. Montana, North Dakota, South Dakota, and Wyoming	100,200	37,100	100	252,625	42,140	2,800	9,200
Group 11. Colorado, New Mexico, and Utah	1,372,929	3,124,300	399,329	1,381,950	3,472,500	272,900	62,887
Group 12. Alaska, Idaho, Oregon, and Washington	120,427	951	706,689	167,600	3,950	15,000	
Group 13. Arizona, California, and Nevada	2,550	199,900	124,842	45,400	77,350	80,000	50
Total	18,150,618	4,668,399	1,811,253	21,804,285	4,735,480	424,575	721,430
Grand total	**24,630,270**			**27,685,770**			

TABLE 5.—*Amount of explosives used in coal mines, and coal-mine fatalities due to explosives during 1912 and 1913.*

States.	1912			1913		
	Explosives used.	Total fatalities due to explosives.	Fatalities per 1,000,000 pounds of explosives.	Explosives used.	Total fatalities due to explosives.	Fatalities per 1,000,000 pounds of explosives.
	Pounds.			*Pounds.*		
Pennsylvania	88,021,347	83	0.94	88,940,451	79	0.89
West Virginia	15,031,915	6	.40	17,787,929	8	.45
Illinois	37,305,432	10	.27	31,968,145	11	.34
Ohio	6,829,550	6	.88	6,202,343	6	.97
Indiana, Michigan, and Kentucky	19,364,223	3	.15	19,048,470	5	.26
Alabama, Mississippi, Tennessee, Georgia, and North Carolina	12,847,460	5	.39	12,940,339	2	.15
Iowa, Kansas, and Missouri	24,328,345	5	.20	11,715,735	6	.51
Colorado, New Mexico, and Utah	4,108,694	1	.24	3,804,580	7	1.89
Maryland and Virginia	2,201,575	10	4.54	3,653,826	2	.55
Montana, North Dakota, and Wyoming	5,620,650	2	.36	4,396,850	4	.91
Arkansas, Oklahoma, and Texas	9,263,875	1	.11	7,987,892	5	.63
Alaska, California, Idaho, Nevada, Oregon, and Washington	1,218,977	1	.82	906,378	3	3.30
Rhode Island	3,000	....	....	....	....	....
Total	226,145,043	133	.59	209,352,938	138	.66

TABLE 6.—*Yearly sales of short-flame explosives used in coal mines in the United States, 1901–1913.*

Year.	Quantity sold.	Year.	Quantity sold.
	Pounds.		*Pounds.*
1901	....	1908	2,108,610
1902	11,300	1909	8,942,857
1903	288,661	1910	11,820,836
1904	608,270	1911	13,428,239
1905	1,031,300	1912	18,150,618
1906	1,533,575	1913	21,804,285
1907	2,095,244		

TABLE 7.—*Quantity of permissible explosives used in different coal fields in the United States, 1909–1913.*

Coal fields and regions.	1909	1910	1911	1912	1913
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1. Pennsylvania anthracite field	894,294	1,486,100	1,917,412	2,177,172	3,294,225
2. Northern Appalachian region [a]	5,976,625	5,967,216	6,350,272	9,190,025	9,744,810
3. Southern Appalachian region	1,434,950	3,188,785	3,377,268	3,995,485	4,481,975
4. Eastern interior field	6,955	165,975	337,012	751,005	2,058,075
5. Western interior field	254,475	196,560	255,050	440,825	377,625
6. Rocky Mountain region	146,700	808,200	1,177,075	1,473,129	1,634,575
7. Pacific coast region	228,858	8,000	14,150	122,977	213,000
	[b] 8,942,857	11,820,836	13,428,239	18,150,618	21,804,285

[a] Not including Pennsylvania anthracite field.

[b] Includes 344,830 pounds of short-flame explosives the permissibility of which had not been determined.

TABLE 8.—*Production of coal in the United States and amount of coal produced per pound of explosives, 1912 and 1913.*

States.[a]	1912		1913	
	Coal production.[b]	Coal produced per pound of explosives.	Coal production.[c]	Coal produced per pound of explosives.
	Short tons.	*Tons.*	*Short tons.*	*Tons.*
Pennsylvania	246,227,086	2.78	265,306,139	2.98
West Virginia	66,786,687	4.44	71,308,982	4.01
Illinois	59,885,226	1.61	61,618,744	1.93
Ohio	34,528,727	5.05	36,200,527	5.84
Indiana, Michigan, and Kentucky	32,982,469	1.70	38,014,057	2.00
Alabama, Mississippi, Tennessee, Georgia, and North Carolina	22,801,531	1.77	24,837,932	1.92
Iowa, Kansas, and Missouri	18,615,567	.77	19,046,271	1.63
Colorado, New Mexico, and Utah	17,530,797	4.27	16,196,144	4.37
Maryland and Virginia	12,810,676	5.82	13,607,907	3.72
Montana, North Dakota, and Wyoming	10,916,099	1.94	11,129,359	2.53
Arkansas, Oklahoma, and Texas	7,964,849	.86	8,829,021	1.11
Alaska, California, Idaho, Nevada, Oregon, and Washington	3,416,866	2.80	3,953,042	4.36
Total	534,466,580	2.36	570,048,125	2.72

[a] States are grouped the same as in Table 5.
[b] Figures from Mineral Resources of the United States, 1912; U. S. Geol. Survey, 1913.
[c] Figures from Mineral Resources of the United States, 1913; U. S. Geol. Survey, 1914.

PUBLICATIONS ON MINE ACCIDENTS AND TESTS OF EXPLOSIVES.

A limited supply of the following publications of the Bureau of Mines is temporarily available for free distribution. Requests for all publications can not be granted, and applicants should limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines, Washington, D. C.

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls., 4 figs.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls., 5 figs.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 61 pp., 10 pls., 12 figs. Reprint of United States Geological Survey Bulletin 423.

BULLETIN 20. The explosibility of coal dust, by G. S. Rice, with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 204 pp., 14 pls., 28 figs. Reprint of United States Geological Survey Bulletin 425.

BULLETIN 42. The sampling and examination of mine gases and natural gas, by G. A. Burrell and F. M. Seibert. 1913. 116 pp., 2 pls., 23 figs.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1913. 50 pp., 3 pls., 7 figs.

BULLETIN 51. The analysis of black powder and dynamite, by W. O. Snelling and C. G. Storm. 1913. 80 pp., 5 pls., 5 figs.

BULLETIN 56. First series of coal-dust explosion tests in the experimental mine, by G. S. Rice, L. M. Jones, J. K. Clement, and W. L. Egy. 1913. 115 pp., 12 pls., 28 figs.

Bulletin 59. Investigations of detonators and electric detonators, by Clarence Hall and S. P. Howell. 1913. 73 pp., 7 pls., 5 figs.

Bulletin 66. Tests of permissible explosives, by Clarence Hall and S. P. Howell. 1913. 313 pp., 1 pl., 6 figs.

Bulletin 69. Coal-mine accidents in the United States and foreign countries, compiled by F. W. Horton. 1913. 102 pp., 3 pls., 40 figs.

Technical Paper 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1912. 28 pp.

Technical Paper 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

Technical Paper 11. The use of mice and birds for detecting carbon monoxide after mine fires and explosions, by G. A. Burrell. 1912. 15 pp.

Technical Paper 12. The behavior of nitroglycerin when heated, by W. O. Snelling and C. G. Storm. 1912. 14 pp., 1 pl., 2 figs.

Technical Paper 17. The effect of stemming on the efficiency of explosives, by W. O. Snelling and Clarence Hall. 1912. 20 pp., 11 figs.

Technical Paper 18. Magazines and thaw houses for explosives, by Clarence Hall and S. P. Howell. 1912. 34 pp., 1 pl., 5 figs.

Technical Paper 21. The prevention of mine explosions, report and recommendations, by Victor Watteyne, Carl Meissner, and Arthur Desborough. 12 pp. Reprint of United States Geological Survey Bulletin 369.

Technical Paper 30. Mine-accident prevention at Lake Superior iron mines, by D. E. Woodbridge. 1913. 38 pp., 9 figs.

Technical Paper 39. The inflammable gases in mine air, by G. A. Burrell and F. M. Seibert. 1913. 24 pp., 2 figs.

Technical Paper 40. Metal-mine accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 54 pp.

Technical Paper 43. The influence of inert gases on inflammable gaseous mixtures, by J. K. Clement. 1913. 24 pp., 1 pl., 8 figs.

Technical Paper 46. Quarry accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 32 pp..

Technical Paper 48. Coal-mine accidents in the United States, 1896–1912, with monthly statistics for 1912, compiled by F. W. Horton. 1913. 74 pp., 10 figs.

Technical Paper 52. Permissible explosives tested prior to March 1, 1913, by Clarence Hall. 1913. 11 pp.

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Technical Paper 69. Production of explosives in the United States in the calendar year 1912, compiled by A. H. Fay. 8 pp.

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Miners' Circular 3. Coal-dust explosions, by G. S. Rice. 1911. 22 pp.

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MINERS' CIRCULAR 7. Use and misuse of explosives in coal mining, by J. J. Rutledge, with a preface by J. A. Holmes. 1913. 52 pp., 8 figs.

MINERS' CIRCULAR 13. Safety in tunneling, by D. W. Brunton and J. A. Davis. 1913. 19 pp.

MINERS' CIRCULAR 14. Gases found in coal mines, by G. A. Burrell. 1913. 21 pp.

MINERS' CIRCULAR 17. Accidents from falls of rock or ore, by Edwin Higgins. 1914. 15 pp., 8 figs.

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